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     (FILE 'HOME' ENTERED AT 18:19:43 ON 25 SEP 2002)

     FILE 'INSPEC' ENTERED AT 18:19:53 ON 25 SEP 2002
L1         31179 QUANTUM (2A)WELL
L2             4 QUANTUMWELL
L3         31181 L1 OR L2
L4          2817 INTERMIXING OR IID OR QWI
L5          2344 INDUCED (2A)DISORDER######
L6            67 L1 AND L3 AND L4 AND L5
L7         23002 XE OR XENON
L8             0 L6 AND L7
L9          6874 INGAASP
L10            0 L8 AND L9
L11         1867 GAINASP
L12         8698 L9 OR L11
L13           22 L6 AND L12
L14           22 L6 AND L13
L15            0 L7 AND L13
L16        35519 ELEVAT#####
L17         8689 DEEP-LEVEL
L18         9423 DEEP (2A)LEVEL
L19         9423 L17 OR L18
L20            0 L6 AND L19
L21            0 L6 AND L16
L22          171 L1 AND L19
L23            1 L22 AND L4
L24            0 L22L22 AND L5
L25            0
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L13 ANSWER 3 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 2001:6950074 INSPEC DN A2001-14-4255P-040; B2001-07-4320J-088
TI Pulsed-laser-induced **quantum well intermixing**
in GaInAs/**GaInAsP** laser structures.
AU Ong, T.K.; Ooi, B.S.; Lam, Y.L.; Chan, Y.C.; Zhou, Y. (Sch. of Electr. & Electron. Eng., Nanyang Technol. Inst., Singapore)
SO Conference Digest. 2000 Conference on Lasers and Electro-Optics Europe (Cat. No.00TH8505)
Piscataway, NJ, USA: IEEE, 2000. p.1 pp. of xii+394 pp. 1 refs.
Conference: Nice, France, 10-15 Sept 2000
Sponsor(s): Eur. Phys. Soc./IEEE/Lasers & Electro-Opt. Soc.; Opt. Soc. America; Quantum Electron. & Opt. Division
Price: CCCC 0 7803 6319 1/2000/$10.00
ISBN: 0-7803-6319-1
DT Conference Article
TC Experimental
CY United States
LA English

pulsed laser induced disordering

AB Summary form only given. The application of postgrowth bandgap tuning of III-V **quantum well** (QW) structures using pulsed-laser-**induced disordering** (P-LID) in photonic integrated circuits is an attractive alternative to selective growth and regrowth processes. P-LID is impurity free and offers direct writing capability. This technique also requires lower processing cost compared to **quantum well intermixing** (**QWI**) realized using ion implantation. We report a significant modification of the bandgap energy of GaInAs/**GaInAsP** laser structure using the P-LID technique. A Q-switched Nd:YAG laser with wavelength of 1.064 mu m, generating pulses of 8 ns and pulse repetition rate of 10 Hz was used in the experiment. Samples were irradiated at room temperature with normal incidence to the surface and then annealed at 625 degrees C for 120 s using a rapid thermal processor. We demonstrate that the degree of **intermixing** is dependent on the pulse energy density and the irradiation time of the Nd:YAG laser. A maximum bandgap shift of up to 112 meV has been observed. The spatial resolution of this technique was shown to be better than 2.5 mu m. The effect of laser processing on the material structure was investigated using photoluminescence measurements and transmission electron microscopy.
CC A4255P Lasing action in semiconductors; A6822 Surface diffusion, segregation and interfacial compound formation; A4262A Laser materials processing; A6865 Low-dimensional structures: growth, structure and nonelectronic properties; A6180B Ultraviolet, visible and infrared radiation effects; A7865K Optical properties of III-V and II-VI semiconductors (thin films/low-dimensional structures); B4320J Semiconductor lasers; B2530C Semiconductor superlattices, quantum wells and related structures; B4360B Laser materials processing
CT CHEMICAL INTERDIFFUSION; ENERGY GAP; GALLIUM ARSENIDE; GRADIENT INDEX OPTICS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; LASER MATERIALS PROCESSING; PHOTOLUMINESCENCE; **QUANTUM WELL** LASERS; RAPID THERMAL ANNEALING; SEMICONDUCTOR QUANTUM WELLS; TRANSMISSION ELECTRON MICROSCOPY
ST QW laser structures; **pulsed-laser-induced QW intermixing**; postgrowth bandgap tuning; **pulsed-laser-induced disordering**; bandgap energy modification; Q-switched Nd:YAG laser; rapid thermal annealing; pulse energy density dependence; irradiation time dependence; spatial resolution; photoluminescence; transmission electron microscopy; GRIN layers; interdiffusion; 625 C; 1.064 micron; **GaInAs-GaInAsP**
CHI GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss
PHP temperature 8.98E+02 K; wavelength 1.064E-06 m
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As

4M

cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; P cp; V; P; Nd; C; GaInAs-GaInAsP; As; Ga; In

L13 ANSWER 4 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 2000:6544692 INSPEC DN A2000-09-4255P-029; B2000-05-4320J-031
TI Photonic integration of InGaAs/**InGaAsP** laser using low energy arsenic implantation **induced disordering** for **quantum well intermixing**.
AU Lim, H.S.; Ooi, B.S.; Lam, Y.L.; Chan, Y.C. (Sch. of Electr. & Electron. Eng., Nanyang Technol. Inst., Singapore); Aimez, V.; Beauvais, J.; Beerens, J.
SO Technical Digest. CLEO/Pacific Rim '99. Pacific Rim Conference on Lasers and Electro-Optics (Cat. No.99TH8464)
Piscataway, NJ, USA: IEEE, 1999. p.1030-1 vol.3 of 4 vol. xii+1335 pp. 5 refs.
Conference: Seoul, South Korea, 30 Aug-3 Sept 1999
Sponsor(s): Opt. Soc. Korea; IEEE/Lasers & Electro-Opt. Soc.; Opt. Soc. America; Japan Soc. Appl. Phys.; IEICE; Korean Opt. Manuf. Assoc.; COEX(Convention & Exhibition), Seoul
Price: CCCC 0 7803 5661 6/99/$10.00
ISBN: 0-7803-5661-6

Applicant

DT Conference Article
TC Experimental
CY United States
LA English
AB **Quantum well intermixing** (**QWI**) using a neutral impurity **induced disordering** technique is of great interest in producing photonic integrated circuits (PICs). We report a high selectivity **QWI** process using a low energy arsenic implantation **induced disordering** technique. Since it is known that free electrons from impurities result in high optical absorption and degrade the quality of the material after **intermixing**, arsenic, an electrically neutral species in the InGaAs/**InGaAsP** system, was chosen for the process development. The relatively low implantation energy, 360 keV, reduces the damage generation and results in a shallow implantation depth far away from the active region. We have successfully blue shifted **quantum well** laser material with a control on the amount of **intermixing** by varying the dose of As implantation at 200 degrees C. A wide range of differential bandgap shifts going up to 60 meV are reported. PICs such as extended cavity lasers and monolithic multiple wavelength laser sources are currently being investigated using this technique.
CC A4255P Lasing action in semiconductors; A6822 Surface diffusion, segregation and interfacial compound formation; A6180J Ion beam effects; A6475 Solubility, segregation, and mixing; A6170T Doping and implantation of impurities; A7865K Optical properties of III-V and II-VI semiconductors (thin films/low-dimensional structures); A7855E Photoluminescence in II-VI and III-V semiconductors; A4282 Integrated optics; B4320J Semiconductor lasers; B2530C Semiconductor superlattices, quantum wells and related structures; B2550B Semiconductor doping; B4140 Integrated optics; B4270 Integrated optoelectronics
CT CHEMICAL INTERDIFFUSION; ENERGY GAP; GALLIUM ARSENIDE; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; INTEGRATED OPTICS; INTEGRATED OPTOELECTRONICS; ION BEAM MIXING; ION IMPLANTATION; PHOTOLUMINESCENCE; **QUANTUM WELL** LASERS; RAPID THERMAL ANNEALING; SEMICONDUCTOR QUANTUM WELLS
ST photonic integration; photonic integrated circuits; **quantum well intermixing**; **arsenic implantation induced disordering**; low energy; **neutral impurity induced disordering**; high selectivity; blue shift; differential bandgap shifts; extended cavity lasers; monolithic multiple wavelength laser sources; photoluminescence; rapid

thermal processing; implantation anneal; 360 keV; **InGaAs-InGaAsP**
CHI InGaAs-InGaAsP int, InGaAsP int, InGaAs int, As int, Ga int, In int, P int, InGaAsP ss, InGaAs ss, As ss, Ga ss, In ss, P ss
PHP electron volt energy 3.6E+05 eV
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; InGaAs; In cp; cp; Ga cp; As cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAsP; P cp; Cs*I*P; PICs; I cp; Cs cp; As; C; V; InGaAs-InGaAsP; Ga; In; P

L13 ANSWER 5 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 2000:6532950 INSPEC DN A2000-08-7865K-028
TI High-spatial-resolution **quantum-well intermixing** process in GaInAs/**GaInAsP** laser structure using pulsed-photoabsorption-**induced disordering**.
AU Ong, T.K.; Gunawan, O.; Ooi, B.S.; Lam, Y.L.; Chan, Y.C.; Zhou, Y. (Sch. of Electr. & Electron. Eng., Nanyang Technol. Univ., Singapore); Helmy, A.S.; Marsh, J.H.
SO Journal of Applied Physics (15 March 2000) vol.87, no.6, p.2775-9. 19 refs.
Doc. No.: S0021-8979(00)04106-2
Published by: AIP
Price: CCCC 0021-8979/2000/87(6)/2775(5)/$17.00
CODEN: JAPIAU ISSN: 0021-8979
SICI: 0021-8979(20000315)87:6L.2775:HSRQ;1-W
DT Journal
TC Experimental
CY United States
LA English

Appl Crane.

AB Raman spectroscopy was used to study the spatial resolution of pulsed-photoabsorption-induced **quantum-well intermixing** in a GaInAs/**GaInAsP** laser structure. A differential band gap shift of up to 60 meV has been obtained from a sample masked with SixNy/Au and exposed to the laser irradiation. **Intermixing** was detected in the irradiated regions through the shift of GaAs-like modes to lower frequencies. In addition, the **intermixing** induced GaInP longitudinal optical modes in the irradiated regions, which is evidence of the **intermixing** between the upper GaInAs cap and the **GaInAsP** layer. The spatial resolution of this process, which was obtained from micro-Raman spectra when scanned across the interface of the **intermixing** mask, was found to be better than 2.5 mu m.
CC A7865K Optical properties of III-V and II-VI semiconductors (thin films/low-dimensional structures); A7830G Infrared and Raman spectra in inorganic crystals; A6865 Low-dimensional structures: growth, structure and nonelectronic properties; A7320D Electron states in low-dimensional structures; A4255P Lasing action in semiconductors; A6630N Chemical interdiffusion in solids; A6822 Surface diffusion, segregation and interfacial compound formation; A6180B Ultraviolet, visible and infrared radiation effects; A6322 Phonons in low-dimensional structures and small particles
CT CHEMICAL INTERDIFFUSION; ENERGY GAP; GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; LASER BEAM EFFECTS; PHONON SPECTRA; **QUANTUM WELL** LASERS; RAMAN SPECTRA; SEMICONDUCTOR QUANTUM WELLS
ST **high-spatial-resolution quantum-well intermixing process; GaInAs/GaInAsP laser structure; pulsed-photoabsorption-induced disordering**; Raman spectroscopy; differential band gap shift; laser irradiation; GaAs-like modes; **intermixing induced GaInP longitudinal optical modes**; upper GaInAs cap; **GaInAsP layer** ; spatial resolution; micro-Raman spectra; **GaInAs-GaInAsP**
CHI GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As

cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; P cp; N*Si; SixNy; Si cp; N cp; As*Ga; As sy 2; sy 2; Ga sy 2; GaAs; Ga*In*P; P sy 3; GaInP; V; GaInAs-GaInAsP; As; Ga; In; P

L13 ANSWER 6 OF 22 INSPEC COPYRIGHT 2002 IEE

AN 2000:6529654 INSPEC DN A2000-08-6865-019; B2000-04-2530C-055

TI High spatial resolution **quantum well intermixing** process in GaInAs/**GaInAsP** laser structures.

AU Ong, T.K.; Ooi, B.S.; Lam, Y.L.; Chan, Y.C.; Rao, M.K. (Sch. of Electr. & Electron. Eng., Nanyang Technol. Inst., Singapore)

SO Technical Digest. CLEO/Pacific Rim '99. Pacific Rim Conference on Lasers and Electro-Optics (Cat. No.99TH8464)
Piscataway, NJ, USA: IEEE, 1999. p.193-4 vol.2 of 4 vol. xii+1335 pp. 5 refs.
Conference: Seoul, South Korea, 30 Aug-3 Sept 1999
Sponsor(s): Opt. Soc. Korea; IEEE/Lasers & Electro-Opt. Soc.; Opt. Soc. America; Japan Soc. Appl. Phys.; IEICE; Korean Opt. Manuf. Assoc.; COEX(Convention & Exhibition), Seoul
Price: CCCC 0 7803 5661 6/99/$10.00
ISBN: 0-7803-5661-6

APPLICANT

DT Conference Article

TC Experimental

CY United States

LA English

AB **Quantum well intermixing** (**QWI**) has been developed in III-V semiconductors to modify the **quantum well** (QW) profile in selected regions to enhance the blue shift of the optical absorption edge after growth. Laser **induced disordering** (LID) is one of the **QWI** techniques, which is impurity free and offers the possibility of direct writing capability. Pulsed-photoabsorption **induced disordering** (P-PAID) is a LID technique whereby the absorption of high-energy pulses from Nd:YAG laser pulses causes bond breaking and lattice disruption leading to an increased density of point defects. Subsequent high temperature annealing results in diffusion of the point defects and enhances the **QWI** rate. The laser pulses used were of similar duration to the thermal time constant of InP in order to minimize the effects of lateral diffusion. So far, photoluminescence (PL) spectroscopy measurements have demonstrated that the spatial resolution of the process is better than 25 mu m. Time resolved photoluminescence measurements of the same sample have indicated a spatial resolution better than 20 mu m. Micro-Raman spectra were taken in a backscattering configuration in an increment of 2.5 mu m from the gold masked region.

CC A6865 Low-dimensional structures: growth, structure and nonelectronic properties; A7855E Photoluminescence in II-VI and III-V semiconductors; A7830G Infrared and Raman spectra in inorganic crystals; A7865K Optical properties of III-V and II-VI semiconductors (thin films/low-dimensional structures); A7847 Ultrafast optical measurements in condensed matter; A6630N Chemical interdiffusion in solids; A6822 Surface diffusion, segregation and interfacial compound formation; A4255P Lasing action in semiconductors; B2530C Semiconductor superlattices, quantum wells and related structures; B4320J Semiconductor lasers

CT CHEMICAL INTERDIFFUSION; GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; PHOTOLUMINESCENCE; POINT DEFECTS; **QUANTUM WELL** LASERS; RAMAN SPECTRA; SEMICONDUCTOR QUANTUM WELLS; TIME RESOLVED SPECTRA

ST **GaInAs/GaInAsP laser structures; high spatial resolution quantum well intermixing process**; III-V semiconductors; blue shift; optical absorption edge; **laser induced disordering**; direct writing capability; **pulsed-photoabsorption induced disordering**; high-energy pulses; absorption; Nd:YAG laser pulses; bond breaking; lattice disruption; point defects; high temperature annealing; thermal

InGaAsP quaternary quantum wells with the separate confinement heterostructure (SCH). The PAID method is particularly useful for multiple-wavelength DFB laser arrays for wavelength-division-multiplexed systems where every wavelength must be aligned with predefined channels.

CC A4260F Laser beam modulation, pulsing and switching; mode locking and tuning; A4255P Lasing action in semiconductors; A4260B Design of specific laser systems; A7820D Optical constants and parameters; A7865J Optical properties of nonmetallic thin films; A6855 Thin film growth, structure, and epitaxy; B4320J Semiconductor lasers

CT DISTRIBUTED FEEDBACK LASERS; ENERGY GAP; GALLIUM ARSENIDE; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; LASER TUNING; LIGHT ABSORPTION; **QUANTUM WELL** LASERS; REFRACTIVE INDEX; RIDGE WAVEGUIDES; SEMICONDUCTOR LASER ARRAYS; WAVEGUIDE LASERS

ST wavelength trimming; distributed-feedback lasers; **photo-absorption-induced disordering**; post-fabrication adjustment; lasing wavelength; 1.55 mu m ridge waveguide DFB laser; active region; **five compressively-strained 1.55 mu m InGaAsP quaternary quantum wells**; separate confinement heterostructure; multiple-wavelength DFB laser arrays; wavelength-division-multiplexed systems; predefined channels; wavelength alignment; band gap dependent absorption; incident laser photons; **quantum well layers**; **QW intermixing**; 1.55 mum; **InGaAsP**

CHI InGaAsP int, As int, Ga int, In int, P int, InGaAsP ss, As ss, Ga ss, In ss, P ss

PHP wavelength 1.55E-06 m

ET As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAsP; In cp; cp; Ga cp; As cp; P cp; V; As; Ga; In; P

L13 ANSWER 12 OF 22 INSPEC COPYRIGHT 2002 IEE

AN 1997:5643651 INSPEC DN A9717-4282-003; B9709-4140-003

TI Laser induced **quantum well intermixing** for optoelectronic devices.

AU Marsh, J.H. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK)

SO Conference Proceedings. LEOS '96 9th Annual Meeting. IEEE Lasers and Electro-Optics Society 1996 Annual Meeting (Cat. No.96CH35895)
New York, NY, USA: IEEE, 1996. p.380-1 vol.2 of 2 vol. (xviii+400+xx+438) pp. 11 refs.
Conference: Boston, MA, USA, 18-19 Nov 1996
ISBN: 0-7803-3160-5

DT Conference Article

TC Practical; Experimental

CY United States

LA English

AB Laser induced **quantum well intermixing** (**QWI**), using CW and pulsed Nd:YAG lasers, is a powerful photonic integration technology. The bandgap of the intermixed alloy is larger than that of the original QW structure and the refractive index is modified, thus providing a route to the formation of low loss waveguides, laser structures, gratings and other optical components. Results from the InP and GaAs systems, covering wavelengths from 1.5 mu m to the visible, are presented. The photo-absorption **induced disordering** (PAID) and pulsed-PAID (P-PAID) **QWI** techniques are described and their application to several material systems reported. Despite their apparent similarities, the underlying physical processes involved in the two techniques are very different. PAID is essentially the result of sample heating through single photon absorption, whilst P-PAID is the result of bond breaking through rapid transient heating through multi-photon processes. In both cases, bandgap tuned optoelectronic devices have been fabricated in the intermixed material, so demonstrating that the material is of high electrical and optical quality.

CC A4282 Integrated optics; A6865 Layer structures, intercalation compounds and superlattices: growth, structure and nonelectronic properties; A7865J

Optical properties of nonmetallic thin films; A4255P Lasing action in semiconductors; A4260B Design of specific laser systems; A4280L Optical waveguides and couplers; A4280F Gratings, echelles; A7820D Optical constants and parameters; A4285D Optical fabrication, surface grinding; A4260K Laser beam applications; B4140 Integrated optics; B4270 Integrated optoelectronics; B2530C Semiconductor superlattices, quantum wells and related structures; B4320J Semiconductor lasers; B4130 Optical waveguides; B4360 Laser applications; B2520D II-VI and III-V semiconductors

CT DIFFRACTION GRATINGS; ENERGY GAP; GALLIUM ARSENIDE; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; INTEGRATED OPTICS; INTEGRATED OPTOELECTRONICS; LASER MATERIALS PROCESSING; MULTIPHOTON PROCESSES; OPTICAL FABRICATION; OPTICAL WAVEGUIDES; PHOTOTHERMAL EFFECTS; **QUANTUM WELL** LASERS; REFRACTIVE INDEX; SEMICONDUCTOR QUANTUM WELLS

ST **laser induced quantum well intermixing**; optoelectronic devices; pulsed Nd:YAG lasers; CW lasers; photonic integration technology; bandgap; intermixed alloy; refractive index; low loss waveguides; laser structures; gratings; optical components; **photo-absorption induced disordering** ; pulsed-PAID; physical processes; sample heating; single photon absorption; bond breaking; rapid transient heating; multi-photon processes; bandgap tuned optoelectronic devices; intermixed material; high electrical quality; high optical quality; 1.5 mum to 700 nm; AlGaInAs-AlGaAs; **GaInAs-GaInAsP**; **GaInAsP**; GaAs-AlGaAs; InP; GaAs

CHI AlGaInAs-AlGaAs int, AlGaInAs int, AlGaAs int, Al int, As int, Ga int, In int, AlGaInAs ss, AlGaAs ss, Al ss, As ss, Ga ss, In ss; GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss; GaInAsP int, As int, Ga int, In int, P int, GaInAsP ss, As ss, Ga ss, In ss, P ss; GaAs-AlGaAs int, AlGaAs int, GaAs int, Al int, As int, Ga int, AlGaAs ss, Al ss, As ss, Ga ss, GaAs bin, As bin, Ga bin; InP int, In int, P int, InP bin, In bin, P bin; GaAs int, As int, Ga int, GaAs bin, As bin, Ga bin

PHP wavelength 7.0E-07 to 1.5E-06 m

ET Nd; In*P; InP; In cp; cp; P cp; As*Ga; As sy 2; sy 2; Ga sy 2; GaAs; Ga cp; As cp; P; V; Al*As*Ga*In; Al sy 4; sy 4; As sy 4; Ga sy 4; In sy 4; AlGaInAs; Al cp; AlGaAs; AlGaInAs-AlGaAs; As*Ga*In*P; P sy 4; GaInAs; GaInAsP; GaInAs-GaInAsP; Al*As*Ga; Al sy 3; sy 3; As sy 3; Ga sy 3; GaAs-AlGaAs; Al; As; Ga; In; As*Ga*In; In sy 3

L13 ANSWER 13 OF 22 INSPEC COPYRIGHT 2002 IEE

AN 1996:5475390 INSPEC DN A9704-7865-049; B9702-2530C-134

TI Monolithic integration in InGaAs-**InGaAsP** multiple-**quantum-well** structures using laser **intermixing**
.

AU McKee, A.; McLean, C.J.; Lullo, G.; Bryce, A.C.; De La Rue, R.M.; Marsh, J.H. (Optoelectron. Res. Group, Glasgow Univ., UK); Button, C.C.

SO IEEE Journal of Quantum Electronics (Jan. 1997) vol.33, no.1, p.45-55. 26 refs.
Doc. No.: S0018-9197(97)00350-3
Published by: IEEE
Price: CCCC 0018-9197/97/$10.00
CODEN: IEJQA7 ISSN: 0018-9197
SICI: 0018-9197(199701)33:1L.45:MIII;1-2

DT Journal

TC Theoretical; Experimental

CY United States

LA English

AB The bandgap of InGaAs-**InGaAsP** multiple-**quantum-well** (MQW) material can be accurately tuned by photoabsorption-**induced disordering** (PAID), using a Nd:YAG laser, to allow lasers, modulators, and passive waveguides to be fabricated from a standard MQW structure. The process relies on optical absorption in the active region of the MQW to produce sufficient heat to cause

interdiffusion between the wells and barriers. Bandgap shifts larger than 100 meV are obtainable using laser power densities of around 5 W.mm-2 and periods of illumination of a few minutes to tens of minutes. This process provides an effective way of altering the emission wavelengths of lasers fabricated from a single epitaxial wafer. Blue shifts of up to 160 nm in the lasing spectra of both broad-area and ridge waveguide lasers are reported. The bandgap-tuned lasers are assessed in terms of threshold current density, internal quantum efficiency, and internal losses. The ON/OFF ratios of bandgap-tuned electroabsorption modulators were tested over a range of wavelengths, with modulation depths of 20 dB obtained from material which has been bandgap-shifted by 120 nm, while samples shifted by 80 nm gave modulation depths as high as 27 dB. Single-mode waveguide losses are as low as 5 dB.cm-1 at 1550 mm. Selective-area disordering has been used in the fabrication of extended cavity lasers. The retention of good electrical and optical properties in intermixed material demonstrates that PAID is a promising technique for the integration of devices to produce photonic integrated circuits. A **quantum-well intermixing** technique using a pulsed laser is also demonstrated.

CC A7865J Optical properties of nonmetallic thin films; A4255P Lasing action in semiconductors; A4280K Optical beam modulators; A4280L Optical waveguides and couplers; A4282 Integrated optics; A4285D Optical fabrication, surface grinding; A6630N Chemical interdiffusion in solids; A4260D Laser resonators and cavities; A4260F Laser beam modulation, pulsing and switching; mode locking and tuning; B2530C Semiconductor superlattices, quantum wells and related structures; B4320J Semiconductor lasers; B4150 Electro-optical devices; B4130 Optical waveguides; B4140 Integrated optics; B4270 Integrated optoelectronics; B4320L Laser resonators and cavities

CT CHEMICAL INTERDIFFUSION; CURRENT DENSITY; ELECTRO-OPTICAL MODULATION; ENERGY GAP; GALLIUM ARSENIDE; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; INFRARED SOURCES; INTEGRATED OPTOELECTRONICS; LASER CAVITY RESONATORS; LASER MODES; LASER TRANSITIONS; LASER TUNING; OPTICAL FABRICATION; OPTICAL LOSSES; OPTICAL PLANAR WAVEGUIDES; **QUANTUM WELL** LASERS; RIDGE WAVEGUIDES; TUNING; WAVEGUIDE LASERS

ST monolithic integration; **InGaAs-InGaAsP multiple-quantum-well structures; laser intermixing**; bandgap; **photoabsorption-induced disordering**; Nd:YAG laser; modulators; passive waveguides; optical absorption; active region; interdiffusion; bandgap shifts; laser power densities; emission wavelengths; epitaxial wafer; blue shifts; ridge waveguide lasers; bandgap-tuned lasers; threshold current density; internal quantum efficiency; internal losses; ON/OFF ratios; 5 W; 1550 nm; **InGaAs-InGaAsP**; YAG:Nd; YAl5O12:Nd

CHI InGaAs-InGaAsP int, InGaAsP int, InGaAs int, As int, Ga int, In int, P int, InGaAsP ss, InGaAs ss, As ss, Ga ss, In ss, P ss; YAl5O12:Nd ss, YAl5O12 ss, Al5O12 ss, Al5 ss, O12 ss, Al ss, Nd ss, O ss, Y ss, Nd el, Nd dop

PHP power 5.0E+00 W; wavelength 1.55E-06 m

ET As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAs; In cp; cp; Ga cp; As cp; InGaAsP; P cp; InGaAs-InGaAsP; Nd; B; V; Al*O*Y; Al sy 3; sy 3; O sy 3; Y sy 3; YAl5O; Y cp; Al cp; O cp; As*Ga*In; As sy 3; Ga sy 3; In sy 3; As; Ga; In; P; Al*O; Al5O; Al; O; Y

L13 ANSWER 14 OF 22 INSPEC COPYRIGHT 2002 IEE

AN 1996:5446563 INSPEC DN A9702-4285-022; B9701-4140-017

TI Fabrication of **quantum well** photonic integrated circuits using laser processing.

AU Marsh, J.H.; Bryce, A.C.; De la Rue, R.M.; McLean, C.J.; McKee, A.; Lullo, G. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK)

SO Applied Surface Science (Oct. 1996) vol.106, p.326-34. 16 refs.
Doc. No.: S0169-4332(96)00414-X
Published by: Elsevier
Price: CCCC 0169-4332/96/$15.00

CODEN: ASUSEE ISSN: 0169-4332
SICI: 0169-4332(199610)106L.326:FQWP;1-W
Conference: Second International Conference on Photo-Excited Processes and Applications. Jerusalem, Israel, 17-21 Sept 1995
Sponsor(s): Center for Tech. Educ. Holon; Tel-Aviv Univ.; Hebrew Univ.; et al

DT Conference Article; Journal
TC Experimental
CY Netherlands
LA English

AB The bandgap of InGaAs-**InGaAsP** multiple-**quantum well** (MQW) material can be accurately tuned by photo-absorption **induced disordering** (PAID), using a Nd:YAG laser, to allow lasers, modulators and passive waveguides to be fabricated from a standard MQW structure. The process relies on optical absorption in the active region of the MQW to produce sufficient heat to cause interdiffusion between the wells and barriers. Blue shifts of up to 160 nm in the lasing spectra of both broad area and ridge waveguide lasers are reported. Bandgap tuned electro-absorption modulators were fabricated and modulation depths as high as 27 dB were obtained. Single mode waveguide losses are as low as 5 dB cm-1 at 1550 nm. Selective area disordering has been used in the fabrication of extended cavity lasers. The retention of good electrical and optical properties in intermixed material demonstrates that PAID is a promising technique for the integration of devices to produce photonic integrated circuits. A **quantum well intermixing** technique using a pulsed laser is also reported.

CC A4285D Optical fabrication, surface grinding; A4280K Optical beam modulators; A6822 Surface diffusion, segregation and interfacial compound formation; A4280L Optical waveguides and couplers; A4255P Lasing action in semiconductors; A4260B Design of specific laser systems; A4282 Integrated optics; B4140 Integrated optics; B4270 Integrated optoelectronics; B4150 Electro-optical devices; B4130 Optical waveguides; B4320J Semiconductor lasers

CT CHEMICAL INTERDIFFUSION; ELECTRO-OPTICAL MODULATION; GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; INTEGRATED OPTICS; INTEGRATED OPTOELECTRONICS; LASER MATERIALS PROCESSING; OPTICAL FABRICATION; OPTICAL LOSSES; OPTICAL WAVEGUIDES; **QUANTUM WELL** LASERS; SEMICONDUCTOR QUANTUM WELLS; SPECTRAL LINE SHIFT; WAVEGUIDE LASERS

ST photonic integrated circuits; laser processing; **multiple-quantum well**; bandgap tuning; **photo-absorption induced disordering**; Nd:YAG laser; optical absorption; interdiffusion; blue shifts; ridge waveguide lasers; electro-absorption modulators; single mode waveguide losses; extended cavity lasers; pulsed laser; broad area lasers; **InGaAs-InGaAsP**

CHI InGaAs-InGaAsP int, InGaAsP int, InGaAs int, As int, Ga int, In int, P int, InGaAsP ss, InGaAs ss, As ss, Ga ss, In ss, P ss

ET As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAs; In cp; cp; Ga cp; As cp; InGaAsP; P cp; InGaAs-InGaAsP; Nd; B; V; As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; As; Ga; In; P

L13 ANSWER 15 OF 22 INSPEC
AN 1996:5338501 INSPEC DN A9618-7855-005
TI Time-resolved photoluminescence microscopy of GaInAs/**GaInAsP** quantum wells intermixed using a pulsed laser technique.
AU Fancey, S.J.; Buller, G.S.; Massa, J.S.; Walker, A.C. (Dept. of Phys., Heriot-Watt Univ., Edinburgh, UK); McLean, C.J.; McKee, A.; Bryce, A.C.; Marsh, J.H.; De La Rue, R.M.
SO Journal of Applied Physics (15 June 1996) vol.79, no.12, p.9390-2. 16 refs.
Doc. No.: S0021-8979(96)06312-8
Published by: AIP

Price: CCCC 0021-8979/96/79(12)/9390/3/$10.00
CODEN: JAPIAU ISSN: 0021-8979
SICI: 0021-8979(19960615)79:12L.9390:TRPM;1-8
DT Journal
TC Experimental
CY United States
LA English
AB High spatial resolution time-resolved photoluminescence has been used to study GaInAs/**GaInAsP quantum-well** structures selectively intermixed using the pulsed photoabsorption-**induced disordering** technique. Photoluminescence decay measurements at wavelengths >1.3 mu m were obtained using novel high-efficiency photon-counting defectors and were found to correlate spatially with the observed luminescence blue shift in these structures. Results indicate a reduction in the nonradiative recombination time of nearly two orders of magnitude as a result of this **intermixing** technique.
CC A7855D Photoluminescence in tetrahedrally bonded nonmetals; A6865 Layer structures, intercalation compounds and superlattices: growth, structure and nonelectronic properties; A7865J Optical properties of nonmetallic thin films; A7847 Ultrafast optical measurements in condensed matter; A6180B Ultraviolet, visible and infrared radiation effects
CT GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; LASER BEAM EFFECTS; NONRADIATIVE TRANSITIONS; PHOTOLUMINESCENCE; SEMICONDUCTOR QUANTUM WELLS; SPECTRAL LINE SHIFT; TIME RESOLVED SPECTRA
ST time-resolved photoluminescence microscopy; **GaInAs/GaInAsP quantum wells**; pulsed laser technique; high spatial resolution; **pulsed photoabsorption-induced disordering technique**; high-efficiency photon-counting defectors; luminescence blue shift; nonradiative recombination time; **intermixing technique**; **GaInAs-GaInAsP**
CHI GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; P cp; V; GaInAs-GaInAsP; As; Ga; In; P

L13 ANSWER 16 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1996:5170016 INSPEC DN A9604-7865-066; B9603-2550B-015
TI Focused ion beam implantation-**induced disordering** in **InGaAsP** MQW heterostructures [studied by photoluminescence].
AU Elenkrig, B.B.; Yang, J.; Cassidy, D.T.; Bruce, D.M.; Lakshmi, B. (Dept. of Eng. Phys., McMaster Univ., Hamilton, Ont., Canada); Champion, G.
SO Conference Proceedings. Seventh International Conference on Indium Phosphide and Related Materials (Cat. No.95CH35720)
New York, NY, USA: IEEE, 1995. p.612-15 of xiv+869 pp. 5 refs.
Conference: Hokkaido, Japan, 9-13 May 1995
Sponsor(s): Japan Soc. Appl. Physics; IEEE Lasers & Electro-Opt. Soc.; IEEE Electron Devices Soc.; IEICE of Japan; Optoelecton. Ind. & Technol. Dev. Assoc.; Res. & Dev. Assoc. Future Electron. Devices
ISBN: 0-7803-2147-2
DT Conference Article
TC Experimental
CY United States
LA English
AB Results of an investigation of the effects of focused ion beam (FIB) implantation-induced **intermixing** of an **InGaAsP**-based multiple **quantum well** (MQW) structure on the room temperature photoluminescence (PL) are presented. The technique of spatially, spectrally and polarization resolved PL was used to study the process of QWs **intermixing** by Si+, Be+ and B+. It was found that implantation in a narrow (about 100 nm) line leads to an enhancement of PL

AK

Good.

yield. A qualitative explanation for this enhancement is given in terms of spatial bandstructure bending due to a doping effect in a narrow region.

CC A7865J Optical properties of nonmetallic thin films; A6865 Layer structures, intercalation compounds and superlattices: growth, structure and nonelectronic properties; A7340L Semiconductor-to-semiconductor contacts, p-n junctions, and heterojunctions; A6822 Surface diffusion, segregation and interfacial compound formation; A6180J Ion beam effects; A6630N Chemical interdiffusion in solids; A6170T Doping and implantation of impurities; A7855D Photoluminescence in tetrahedrally bonded nonmetals; A4285D Optical fabrication, surface grinding; A4255P Lasing action in semiconductors; A4260B Design of specific laser systems; B2550B Semiconductor doping; B2530C Semiconductor superlattices, quantum wells and related structures; B2520D II-VI and III-V semiconductors; B4320J Semiconductor lasers

CT CHEMICAL INTERDIFFUSION; FOCUSED ION BEAM TECHNOLOGY; GALLIUM ARSENIDE; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; ION BEAM MIXING; ION IMPLANTATION; OPTICAL FABRICATION; PHOTOLUMINESCENCE; **QUANTUM WELL** LASERS; RAPID THERMAL ANNEALING; SEMICONDUCTOR QUANTUM WELLS

ST MQW heterostructures; **implantation-induced disordering; FIB implantation-induced intermixing**; room temperature photoluminescence; polarization resolved; spectrally resolved; spatially resolved; Si+; Be+; B+; yield enhancement; spatial bandstructure bending; narrow region doping effect; III-V semiconductor; n-type doped region; RTA; lattice matched structure; MQW lasers; **InGaAsP; InGaAsP:B; InGaAsP:Si; InGaAsP:Be**

CHI InGaAsP int, As int, Ga int, In int, P int, InGaAsP ss, As ss, Ga ss, In ss, P ss; InGaAsP:B int, InGaAsP int, As int, Ga int, In int, B int, P int, InGaAsP:B ss, InGaAsP ss, As ss, Ga ss, In ss, B ss, P ss, B el, B dop; InGaAsP:Si int, InGaAsP int, As int, Ga int, In int, Si int, P int, InGaAsP:Si ss, InGaAsP ss, As ss, Ga ss, In ss, Si ss, P ss, Si el, Si dop; InGaAsP:Be int, InGaAsP int, As int, Be int, Ga int, In int, P int, InGaAsP:Be ss, InGaAsP ss, As ss, Be ss, Ga ss, In ss, P ss, Be el, Be dop

ET As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAsP; In cp; cp; Ga cp; As cp; P cp; Si; Si+; Si ip 1; ip 1; Be; Be+; Be ip 1; B; B+; B ip 1; V; As*B*Ga*In*P; As sy 5; sy 5; B sy 5; Ga sy 5; In sy 5; P sy 5; InGaAsP:B; B doping; doped materials; As*Ga*In*P*Si; Si sy 5; InGaAsP:Si; Si doping; As*Be*Ga*In*P; Be sy 5; InGaAsP:Be; Be doping; As; Ga; In; P

L13 ANSWER 17 OF 22 INSPEC COPYRIGHT 2002 IEE

AN 1996:5164048 INSPEC DN A9604-4260B-034; B9603-4270-001

TI Bandgap tuning of lasers, modulators, and passive waveguides in **GaInAsP** using photo-absorption **induced disordering**.

AU McKee, A.; Lullo, G.; McLean, C.J.; Bryce, A.C.; De La Rue, R.M.; Marsh, J.H. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK)

SO Proceedings of the SPIE - The International Society for Optical Engineering (1995) vol.2401, p.44-52. 17 refs.
Published by: SPIE-Int. Soc. Opt. Eng
Price: CCCC 0 8194 1748 3/95/$6.00
CODEN: PSISDG ISSN: 0277-786X
SICI: 0277-786X(1995)2401L.44:BTLM;1-C
Conference: Functional Photonic Integrated Circuits. San Jose, CA, USA, 9-10 Feb 1995
Sponsor(s): SPIE

DT Conference Article; Journal

TC Experimental

CY United States

LA English

AB The bandgap of **GaInAsP** multi-**quantum well** (MQW) material can be accurately tuned by photo-absorption **induced disordering** (PAID) to allow lasers, modulators and passive waveguides to be fabricated from a standard MQW laser structure. The

bandgap tuned lasers are assessed in terms of threshold current density, internal quantum efficiency and internal losses and exhibit blue shifts in the lasing spectra of up to 160 nm. The ON/OFF ratios of the modulators were tested over a range of wavelengths with modulation depths of 20 dB obtained from material which has been bandgap shifted by 120 nm, while samples shifted at 80 nm gave modulation depths as high as 27 dB. We have also measured single mode waveguide losses over a range of wavelengths and these are 5 dB/cm at 1550 nm. These high quality devices showing good electrical and optical properties after processing demonstrate that PAID is a promising technique for the integration of devices to produce photonic integrated circuits.

CC A4260B Design of specific laser systems; A4285D Optical fabrication, surface grinding; A7340L Semiconductor-to-semiconductor contacts, p-n junctions, and heterojunctions; A7320D Electron states in low-dimensional structures; A7320H Surface impurity and defect levels; energy levels of adsorbed species; A4280L Optical waveguides and couplers; A4280K Optical beam modulators; A4260F Laser beam modulation, pulsing and switching; mode locking and tuning; A4282 Integrated optics; B4270 Integrated optoelectronics; B4320J Semiconductor lasers; B2530C Semiconductor superlattices, quantum wells and related structures; B4130 Optical waveguides; B4150 Electro-optical devices

CT ELECTRO-OPTICAL MODULATION; ENERGY GAP; GALLIUM ARSENIDE; III-V SEMICONDUCTORS; IMPURITY STATES; INDIUM COMPOUNDS; INTEGRATED OPTOELECTRONICS; LASER TUNING; OPTICAL FABRICATION; OPTICAL LOSSES; OPTICAL WAVEGUIDES; **QUANTUM WELL** LASERS; SEMICONDUCTOR QUANTUM WELLS

ST III-V semiconductor; bandgap tuning; **intermixing**; modulators; passive waveguides; **photo-absorption induced disordering**; MQW laser structure; bandgap tuned lasers; threshold current density; internal quantum efficiency; internal losses; blue shifts; ON/OFF ratios; single mode waveguide losses; photonic integrated circuits; 1550 nm; **GaInAsP**

CHI GaInAsP int, As int, Ga int, In int, P int, GaInAsP ss, As ss, Ga ss, In ss, P ss

PHP wavelength 1.55E-06 m

ET As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; Ga cp; cp; In cp; As cp; P cp; B; V; As; Ga; In; P

L13 ANSWER 18 OF 22 INSPEC COPYRIGHT 2002 IEE

AN 1995:5131344 INSPEC DN A9602-4255P-019; B9601-4320J-075

TI High quality wavelength tuned multi-**quantum well** GaInAs/**GaInAsP** lasers fabricated using photo-absorption **induced disordering**.

AU McKee, A.; McLean, C.J.; Bryce, A.C.; Button, C.; De La Rue, R.M.; Marsh, J.H. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK)

SO LEOS '94. Conference Proceedings. IEEE Lasers and Electro-Optics Society 1994 7th Annual Meeting (Cat. No.94CH3371-2)
New York, NY, USA: IEEE, 1994. p.381-2 vol.2 of 2 vol. (xx+345+450) pp. 2 refs.
Conference: Boston, MA, USA, 31 Oct-3 Nov 1994
ISBN: 0-7803-1470-0

DT Conference Article

TC Experimental

CY United States

LA English

AB Oxide stripe lasers have been fabricated from GaInAs/**GaInAsP** multi-**quantum well** material which has undergone various degrees of **intermixing** by photoabsorption **induced disordering** (PAID). Blue shifts of up to 160 nm in the lasing spectra are demonstrated.

CC A4255P Lasing action in semiconductors; A4260F Laser beam modulation, pulsing and switching; mode locking and tuning; A8115H Chemical vapour

deposition; A4285D Optical fabrication, surface grinding; B4320J
Semiconductor lasers; B0510D Epitaxial growth
CT GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; INDIUM
COMPOUNDS; LASER TUNING; OPTICAL FABRICATION; **QUANTUM
WELL** LASERS; SEMICONDUCTOR GROWTH; SPECTRAL LINE SHIFT; VAPOUR
PHASE EPITAXIAL GROWTH
ST **high quality wavelength tuned multi-quantum well GaInAs/GaInAsP
lasers fabrication; photo-absorption induced disordering;**
oxide stripe lasers; **GaInAs/GaInAsP multi-quantum well material;
intermixing;** blue shifts; lasing spectra; 160 nm;
GaInAs-GaInAsP
CHI GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P
int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss
PHP wavelength 1.6E-07 m
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As
cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; P cp; V;
GaInAs-GaInAsP; As; Ga; In; P

L13 ANSWER 19 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1993:4459406 INSPEC DN A9318-4280L-010; B9309-4130-023
TI Very low loss waveguides formed by fluorine **induced
disordering** of GaInAs/**GaInAsP** quantum wells.
AU Bradshaw, S.A.; Marsh, J.H. (Dept. of Electron. & Electr. Eng., Glasgow
Univ., UK); Glew, R.W.
SO Fourth International Conference on Indium Phosphide and Related Materials
(Cat. No.92CH3104-7)
New York, NY, USA: IEEE, 1992. p.604-7 of xx+687 pp. 7 refs.
Conference: Newport, RI, USA, 21-24 April 1992
Sponsor(s): IEEE
ISBN: 0-7803-0522-1
DT Conference Article
TC Practical; Experimental
CY United States
LA English
AB Selective area **intermixing** of **quantum well**
(QW) structures using fluorine as a disordering impurity is demonstrated.
Bandgap widened ridge waveguides have been fabricated using this process
and the resultant waveguides had losses of between 8.5 dB cm-1 and 0.6 dB
cm-1. In purely thermally intermixed samples, the lowest loss measured is
18.5 dB cm-1 and, if an electrically active dopant was used as a
disordering species, a propagation loss due to free-carrier absorption of
greater than 40 dB cm-1 is expected. By implanting with fluorine to give a
concentration of around 1018 cm-3 and annealing at 700 degrees C it is
possible to widen the QW structure by as much as 40 meV, while leaving the
unimplanted structure relatively unchanged. It has also been shown that
SiO2, but not Si3N4, dielectric caps can be used to provide protection
during the annealing stage of the process.
CC A4280L Optical waveguides and couplers; A4282 Integrated optics; B4130
Optical waveguides; B4140 Integrated optics
CT ANNEALING; FLUORINE; GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V
SEMICONDUCTORS; IMPURITIES; INDIUM COMPOUNDS; INTEGRATED OPTICS; OPTICAL
LOSSES; OPTICAL WAVEGUIDES; SEMICONDUCTOR QUANTUM WELLS
ST **selective area intermixing**; F disordering impurity; bandgap
widened ridge waveguides; optoelectronic devices; quantum wells; losses;
electrically active dopant; propagation loss; free-carrier absorption;
annealing; 700 degC; 8.5 to 0.6 dB; 18.5 dB; 40 dB; **GaInAs-GaInAsP**
; Si3N4 dielectric cap; SiO2 dielectric cap
CHI GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P
int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss; Si3N4 int, Si3 int,
N4 int, Si int, N int, Si3N4 bin, Si3 bin, N4 bin, Si bin, N bin; F int, F
ss, F el, F dop; SiO2 int, O2 int, Si int, O int, SiO2 bin, O2 bin, Si
bin, O bin

PHP temperature 9.73E+02 K; loss 6.0E-01 to 8.5E+00 dB; loss 1.85E+01 dB; loss 4.0E+01 dB
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; P cp; B; C; O*Si; SiO2; Si cp; O cp; N*Si; Si3N4; N cp; V; F; GaInAs-GaInAsP; As; Ga; In; P; Si3N; Si; N; SiO; O

L13 ANSWER 20 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1992:4183605 INSPEC DN A9215-4280L-015; B9208-4130-016
TI Impurity **induced disordering** of GaInAs quantum wells with barriers of AlGaInAs or of **GaInAsP** (MQW waveguides).
AU Marsh, J.H.; Bradshaw, S.A.; Bryce, A.C. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK); Gwilliam, R.; Glew, R.W.
SO Third International Conference. Indium Phosphide and Related Materials (Cat. No.91CH2950-4)
New York, NY, USA: IEEE, 1991. p.592-5 of xxiv+678 pp. 5 refs.
Conference: Cardiff, UK, 8-11 April 1991
Sponsor(s): IEEE
ISBN: 0-87942-626-8
DT Conference Article
TC Experimental
CY United States
LA English
AB The use of fluorine and boron to disorder two material systems for use at 1.5 mu m, GaInAs/AlGaInAs and GaInAs/**GaInAsP**, both lattice-matched to InP, is discussed. Three structures are investigated: two **GaInAsP** multiple **quantum well** (MQW) structures, a separate confinement heterostructure (SCH) and a graded index structure (GRIN), and an AlGaInAs MQW structure. It is shown that the P-quaternary disorders without any implants at annealing temperatures above 500 degrees C, and the Al-quaternary is stable up to annealing temperatures of 650 degrees C. At annealing temperatures of 600 degrees C for the P and 650 degrees C for the Al quaternary. boron causes some **intermixing**, probably due to the damage caused by implantation. A significant blue shift was achieved in material implanted with fluorine while, under the same annealing conditions, the control samples remained unchanged.
CC A4280L Optical waveguides and couplers; A4280R Gradient-index (GRIN) devices; A4282 Integrated optics; A6865 Layer structures, intercalation compounds and superlattices: growth, structure and nonelectronic properties; A6170A Annealing processes; A6822 Surface diffusion, segregation and interfacial compound formation; A6180J Ions; B4130 Optical waveguides; B4140 Integrated optics; B2530B Semiconductor junctions
CT ALUMINIUM COMPOUNDS; ANNEALING; GALLIUM ARSENIDE; GRADIENT INDEX OPTICS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; INTEGRATED OPTICS; ION BEAM MIXING; ION IMPLANTATION; OPTICAL WAVEGUIDES; SEMICONDUCTOR QUANTUM WELLS; SPECTRAL LINE SHIFT
ST **impurity induced disordering**; MQW structure; ion implantation; exciton peak shift; optical waveguides; separate confinement heterostructure; graded index structure; GRIN; **intermixing**; blue shift; 500 to 650 degC; 1.5 micron; GaInAs-AlGaInAs; **GaInAs-GaInAsP**; InP substrate; GaInAs:F; GaInAs:B
CHI GaInAs-AlGaInAs int, AlGaInAs int, GaInAs int, Al int, As int, Ga int, In int, AlGaInAs ss, GaInAs ss, Al ss, As ss, Ga ss, In ss; GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss; InP sur, In sur, P sur, InP bin, In bin, P bin; GaInAs:F int, GaInAs int, As int, Ga int, In int, F int, GaInAs:F ss, GaInAs ss, As ss, Ga ss, In ss, F ss, F el, F dop; GaInAs:B int, GaInAs int, As int, Ga int, In int, B int, GaInAs:B ss, GaInAs ss, As ss, Ga ss, In ss, B ss, B el, B dop
PHP temperature 7.73E+02 to 9.23E+02 K; wavelength 1.5E-06 m
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As

cp; Al*As*Ga*In; Al sy 4; sy 4; As sy 4; Ga sy 4; In sy 4; AlGaInAs; Al cp; As*Ga*In*P; P sy 4; GaInAsP; P cp; In*P; InP; P; C; Al; V; GaInAs-AlGaInAs; GaInAs-GaInAsP; As*F*Ga*In; F sy 4; GaInAs:F; F doping; doped materials; As*B*Ga*In; B sy 4; GaInAs:B; B doping; As; Ga; In

L13 ANSWER 21 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1992:4145355 INSPEC DN A9212-6865-005; B9206-2550B-055
TI Neutral impurity disordering of III-V **quantum well** structures for optoelectronics.
AU Marsh, J.H.; Ayling, S.G.; Bryce, A.C.; Hansen, S.I.; Bradshaw, S.A. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK)
SO AIP Conference Proceedings (1991) no.240, p.111-29. 35 refs.
Price: CCCC 0094-243X/91/$2.00
CODEN: APCPCS ISSN: 0094-243X
Conference: Joint Soviet-American Workshop on the Physics of Semiconductor Lasers. Leningrad, USSR, 19 May-3 June 1991
DT Conference Article; Journal
TC Experimental
CY United States
LA English
AB Novel applications of impurity **induced disordering** (**IID**) in semiconductor integrated optoelectronics are discussed and some requirements of the **IID** process are quantified. The effect of the neutral impurities boron and fluorine as disordering species has been studied. In the GaAs/AlGaAs system fluorine disordered multiple **quantum well** waveguide structures exhibited blue shifts of up to 100 meV in the absorption edge (representing complete disordering). The absorption coefficient in partially disordered structures at near band-edge wavelengths was as low as 4.7 dB cm-1. This absorption edge shift was accompanied by substantial changes, >1%, in the refractive index. Disordering of GaInAs/AlGaInAs and GaInAs/**GaInAsP quantum well** structures lattice matched to InP has also been investigated. Boron implantation caused small (10 meV) blue shifts of the exciton peak in both material systems at low annealing temperatures. Much larger blue shifts (up to 90 meV for phosphorus quaternary and 45 meV for aluminium quaternary samples) were observed in the fluorine implanted samples.
CC A6865 Layer structures, intercalation compounds and superlattices: growth, structure and nonelectronic properties; A6170T Doping and implantation of impurities; A4255P Lasing action in semiconductors with junctions; A7865J Nonmetals; A4282 Integrated optics; A7820D Optical constants and parameters; A7850G Semiconductors; B2550B Semiconductor doping; B2530B Semiconductor junctions; B4320J Semiconductor junction lasers; B4140 Integrated optics
CT ALUMINIUM COMPOUNDS; BORON; EXCITONS; FLUORINE; GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; IMPURITY AND DEFECT ABSORPTION SPECTRA OF INORGANIC SOLIDS; INDIUM COMPOUNDS; INTEGRATED OPTICS; ION IMPLANTATION; LUMINESCENCE OF INORGANIC SOLIDS; PHOTOLUMINESCENCE; REFRACTIVE INDEX; SEMICONDUCTOR JUNCTION LASERS; SEMICONDUCTOR QUANTUM WELLS
ST semiconductor lasers; B implantation; photoluminescence; F implantation; **III-V quantum well structures**; optoelectronics; **impurity induced disordering**; semiconductor integrated optoelectronics; neutral impurities; **multiple quantum well waveguide structures**; blue shifts; absorption edge; absorption coefficient; partially disordered structures; near band-edge wavelengths; refractive index; exciton peak; annealing; GaInAs-AlGaInAs:F; GaAs:F-AlGaAs; GaInAs-AlGaInAs:B; GaAs:B-AlGaAs; **GaInAs-GaInAsP:F; GaInAs-GaInAsP:B**
CHI GaInAs-AlGaInAs:F int, AlGaInAs:F int, AlGaInAs int, GaInAs int, Al int, As int, Ga int, In int, F int, AlGaInAs:F ss, AlGaInAs ss, GaInAs ss, Al ss, As ss, Ga ss, In ss, F ss, F el, F dop; GaAs:F-AlGaAs int, AlGaAs int, GaAs:F int, GaAs int, Al int, As int, Ga int, F int, AlGaAs ss, GaAs:F ss, Al ss, As ss, Ga ss, F ss, GaAs bin, As bin, Ga bin, F el, F dop;

GaInAs-AlGaInAs:B int, AlGaInAs:B int, AlGaInAs int, GaInAs int, Al int, As int, Ga int, In int, B int, AlGaInAs:B ss, AlGaInAs ss, GaInAs ss, Al ss, As ss, Ga ss, In ss, B ss, B el, B dop; GaAs:B-AlGaAs int, AlGaAs int, GaAs:B int, GaAs int, Al int, As int, Ga int, B int, AlGaAs ss, GaAs:B ss, Al ss, As ss, Ga ss, B ss, GaAs bin, As bin, Ga bin, B el, B dop; GaInAs-GaInAsP:F int, GaInAsP:F int, GaInAsP int, GaInAs int, As int, Ga int, In int, F int, P int, GaInAsP:F ss, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, F ss, P ss, F el, F dop; GaInAs-GaInAsP:B int, GaInAsP:B int, GaInAsP int, GaInAs int, As int, Ga int, In int, B int, P int, GaInAsP:B ss, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, B ss, P ss, B el, B dop

ET V; As*Ga; As sy 2; sy 2; Ga sy 2; GaAs; Ga cp; cp; As cp; Al*As*Ga; Al sy 3; sy 3; As sy 3; Ga sy 3; AlGaAs; Al cp; B; As*Ga*In; In sy 3; GaInAs; In cp; Al*As*Ga*In; Al sy 4; sy 4; As sy 4; Ga sy 4; In sy 4; AlGaInAs; As*Ga*In*P; P sy 4; GaInAsP; P cp; In*P; InP; F; Al*As*F*Ga*In; Al sy 5; sy 5; As sy 5; F sy 5; Ga sy 5; In sy 5; AlGaInAs:F; F doping; doped materials; GaInAs-AlGaInAs:F; Al*As*F*Ga; F sy 4; GaAs:F; GaAs:F-AlGaAs; Al*As*B*Ga*In; B sy 5; AlGaInAs:B; B doping; GaInAs-AlGaInAs:B; Al*As*B*Ga; B sy 4; GaAs:B; GaAs:B-AlGaAs; As*F*Ga*In*P; P sy 5; GaInAsP:F; GaInAs-GaInAsP:F; As*B*Ga*In*P; GaInAsP:B; GaInAs-GaInAsP:B; Al; As; Ga; In; As*F*Ga; F sy 3; As*B*Ga; B sy 3; P

L13 ANSWER 22 OF 22 INSPEC

AN 1991:4020433 INSPEC DN A91149334

TI InGaAs(P)/InP MQW mixing by Zn diffusion, Ge and S implantation for optoelectronic applications.

AU Julien, F.H.; Bradley, M.A. (Inst. d'Electron. Fondamentale, Paris XI Univ., Orsay, France); Rao, E.V.K.; Razeghi, M.; Goldstein, L.

SO Optical and Quantum Electronics (1991) vol.23, no.7, p.847-61. 36 refs.
Price: CCCC 0306-8919/91/$03.00+.12
CODEN: OQELDI ISSN: 0306-8919
Conference: Quantum Well Mixing. First International Workshop. Jersey, UK, Sept 1990
Sponsor(s): US Army; UK Sci. Eng. Res. Council

DT Conference Article; Journal

TC Experimental

CY United Kingdom

LA English

AB There is a growing interest in impurity-**induced** layer **disordering** for the technologically important InGaAs(P)/InP system. More complicated than in the AlGaAs/GaAs ternary system, which concerns only interdiffusion of group III atoms, interdiffusion in this quaternary system can occur for both group III (Ga,In) and group V(P,As) atoms, which may or may not result in a strain-free alloy lattice-matched to InP, a major concern for device applications. After a brief review on the thermal stability of InP/InGaAs **quantum well** structures, the authors show that Zn diffusion at moderate temperature leads to **intermixing** on the group III sublattice, only, with subsequent lattice mismatch. On the other hand, either Ge or S implantation of InGaAs/InP quantum wells results in **intermixing** involving both the group III and the group V sublattice and approximating the lattice-matched condition.

CC A6822 Surface diffusion, segregation and interfacial compound formation; A6865 Layer structures, intercalation compounds and superlattices: growth, structure and nonelectronic properties; A6630N Chemical interdiffusion; A6630J Diffusion, migration, and displacement of impurities; A6170T Doping and implantation of impurities; A6475 Solubility, segregation, and mixing; A6180J Ions

CT CHEMICAL INTERDIFFUSION; DIFFUSION IN SOLIDS; GALLIUM ARSENIDE; GERMANIUM; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; ION BEAM MIXING; ION IMPLANTATION; SEMICONDUCTOR QUANTUM WELLS; SULPHUR; ZINC

ST Ge implantation; semiconductor; MQW mixing; Zn diffusion; S implantation; optoelectronic applications; **impurity-induced layer disordering**;

interdiffusion; thermal stability; **quantum well structures**; lattice mismatch; **intermixing**; lattice-matched condition; **InGaAsP-InP:Zn; InGaAsP-InP:Ge; InGaAsP-InP:S**

CHI InGaAsP-InP:Zn int, InGaAsP int, InP:Zn int, InP int, As int, Ga int, In int, Zn int, P int, InGaAsP ss, InP:Zn ss, As ss, Ga ss, In ss, Zn ss, P ss, InP bin, In bin, P bin, Zn el, Zn dop; InGaAsP-InP:Ge int, InGaAsP int, InP:Ge int, InP int, As int, Ga int, Ge int, In int, P int, InGaAsP ss, InP:Ge ss, As ss, Ga ss, Ge ss, In ss, P ss, InP bin, In bin, P bin, Ge el, Ge dop; InGaAsP-InP:S int, InGaAsP int, InP:S int, InP int, As int, Ga int, In int, P int, S int, InGaAsP ss, InP:S ss, As ss, Ga ss, In ss, P ss, S ss, InP bin, In bin, P bin, S el, S dop

ET As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAs(P); In cp; cp; Ga cp; As cp; P cp; In*P; InP; Zn; Ge; S; Al*As*Ga; Al sy 3; sy 3; As sy 3; Ga sy 3; AlGaAs; Al cp; As*Ga; As sy 2; sy 2; Ga sy 2; GaAs; Ga; In; P*V; V(P; V cp; As; As*Ga*In; In sy 3; InGaAs; V; As*Ga*In*P*Zn; As sy 5; sy 5; Ga sy 5; In sy 5; P sy 5; Zn sy 5; InGaAsP; InP:Zn; Zn doping; doped materials; InGaAsP-InP:Zn; As*Ga*Ge*In*P; Ge sy 5; InP:Ge; Ge doping; InGaAsP-InP:Ge; As*Ga*In*P*S; S sy 5; InP:S; S doping; InGaAsP-InP:S; In*P*Zn; P sy 3; Zn sy 3; P; Ge*In*P; Ge sy 3; In*P*S

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L13 ANSWER 18 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1995:5131344 INSPEC DN A9602-4255P-019; B9601-4320J-075
TI High quality wavelength tuned multi-**quantum well** GaInAs/**GaInAsP** lasers fabricated using photo-absorption **induced disordering**.
AU McKee, A.; McLean, C.J.; Bryce, A.C.; Button, C.; De La Rue, R.M.; Marsh, J.H. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK)
SO LEOS '94. Conference Proceedings. IEEE Lasers and Electro-Optics Society 1994 7th Annual Meeting (Cat. No.94CH3371-2)
New York, NY, USA: IEEE, 1994. p.381-2 vol.2 of 2 vol. (xx+345+450) pp. 2 refs.
Conference: Boston, MA, USA, 31 Oct-3 Nov 1994
ISBN: 0-7803-1470-0
DT Conference Article
TC Experimental
CY United States
LA English
AB Oxide stripe lasers have been fabricated from GaInAs/**GaInAsP** multi-**quantum well** material which has undergone various degrees of **intermixing** by photoabsorption **induced disordering** (PAID). Blue shifts of up to 160 nm in the lasing spectra are demonstrated.
CC A4255P Lasing action in semiconductors; A4260F Laser beam modulation, pulsing and switching; mode locking and tuning; A8115H Chemical vapour deposition; A4285D Optical fabrication, surface grinding; B4320J Semiconductor lasers; B0510D Epitaxial growth
CT GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; LASER TUNING; OPTICAL FABRICATION; **QUANTUM WELL** LASERS; SEMICONDUCTOR GROWTH; SPECTRAL LINE SHIFT; VAPOUR PHASE EPITAXIAL GROWTH
ST **high quality wavelength tuned multi-quantum well GaInAs/GaInAsP lasers fabrication; photo-absorption induced disordering;** oxide stripe lasers; **GaInAs/GaInAsP multi-quantum well material; intermixing;** blue shifts; lasing spectra; 160 nm; **GaInAs-GaInAsP**
CHI GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss
PHP wavelength 1.6E-07 m
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; P cp; V; GaInAs-GaInAsP; As; Ga; In; P

L13 ANSWER 19 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1993:4459406 INSPEC DN A9318-4280L-010; B9309-4130-023
TI Very low loss waveguides formed by fluorine **induced disordering** of GaInAs/**GaInAsP** quantum wells.
AU Bradshaw, S.A.; Marsh, J.H. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK); Glew, R.W.
SO Fourth International Conference on Indium Phosphide and Related Materials (Cat. No.92CH3104-7)
New York, NY, USA: IEEE, 1992. p.604-7 of xx+687 pp. 7 refs.
Conference: Newport, RI, USA, 21-24 April 1992
Sponsor(s): IEEE
ISBN: 0-7803-0522-1
DT Conference Article
TC Practical; Experimental
CY United States
LA English
AB Selective area **intermixing** of **quantum well** (QW) structures using fluorine as a disordering impurity is demonstrated. Bandgap widened ridge waveguides have been fabricated using this process

and the resultant waveguides had losses of between 8.5 dB cm-1 and 0.6 dB cm-1. In purely thermally intermixed samples, the lowest loss measured is 18.5 dB cm-1 and, if an electrically active dopant was used as a disordering species, a propagation loss due to free-carrier absorption of greater than 40 dB cm-1 is expected. By implanting with fluorine to give a concentration of around 1018 cm-3 and annealing at 700 degrees C it is possible to widen the QW structure by as much as 40 meV, while leaving the unimplanted structure relatively unchanged. It has also been shown that SiO2, but not Si3N4, dielectric caps can be used to provide protection during the annealing stage of the process.

CC A4280L Optical waveguides and couplers; A4282 Integrated optics; B4130 Optical waveguides; B4140 Integrated optics

CT ANNEALING; FLUORINE; GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; IMPURITIES; INDIUM COMPOUNDS; INTEGRATED OPTICS; OPTICAL LOSSES; OPTICAL WAVEGUIDES; SEMICONDUCTOR QUANTUM WELLS

ST **selective area intermixing**; F disordering impurity; bandgap widened ridge waveguides; optoelectronic devices; quantum wells; losses; electrically active dopant; propagation loss; free-carrier absorption; annealing; 700 degC; 8.5 to 0.6 dB; 18.5 dB; 40 dB; **GaInAs-GaInAsP** ; Si3N4 dielectric cap; SiO2 dielectric cap

CHI GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss; Si3N4 int, Si3 int, N4 int, Si int, N int, Si3N4 bin, Si3 bin, N4 bin, Si bin, N bin; F int, F ss, F el, F dop; SiO2 int, O2 int, Si int, O int, SiO2 bin, O2 bin, Si bin, O bin

PHP temperature 9.73E+02 K; loss 6.0E-01 to 8.5E+00 dB; loss 1.85E+01 dB; loss 4.0E+01 dB

ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As cp; As*Ga*In*P; As sy 4; sy 4

ST large bandgap shift; **InGaAs(P)/InP multi-quantum well structure;** impurity-free vacancy diffusion; SiO2 capping; photodetectors application; bandgap tuning; low temperature photoluminescence; **MQW intermixing** ; RTA; blue shift; SiNx capping; absorption spectra; energy shifts; **impurity-induced disordering;** self-interdiffusion; 750 C; 850 C; **InGaAsP-InP;** InGaAs-InP; SiO2

CHI InGaAsP-InP int, InGaAsP int, InP int, As int, Ga int, In int, P int, InGaAsP ss, As ss, Ga ss, In ss, P ss, InP bin, In bin, P bin; InGaAs-InP int, InGaAs int, InP int, As int, Ga int, In int, P int, InGaAs ss, As ss, Ga ss, In ss, InP bin, In bin, P bin; SiO2 int, O2 int, Si int, O int, SiO2 bin, O2 bin, Si bin, O bin

PHP temperature 1.02E+03 K; temperature 1.12E+03 K

ET As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAs(P); In cp; cp; Ga cp; As cp; P cp; In*P; InP; O*Si; SiO2; Si cp; O cp; In; InGaAs(P)-InP; N*Si; SiNx; N cp; As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; InGaAs; C; In*O*P*Si; O sy 4; Si sy 4; SiO2-InP; As*Ga*In*N*Si; As sy 5; sy 5; Ga sy 5; In sy 5; N sy 5; Si sy 5; SiNx-InGaAs; V; InGaAsP; InGaAsP-InP; InGaAs-InP; As; Ga; P; SiO; O; Si

L13 ANSWER 8 OF 22 INSPEC COPYRIGHT 2002 IEE

AN 1998:5902484 INSPEC DN A9811-6170T-005; B9806-2550B-009

TI Plasma immersion Ar+ ion implantation **induced disorder** in strained **InGaAsP** multiple quantum wells.

AU Lam, L.M.; Kwong, C.W.; Ho, H.P. (Dept. of Phys. & Mater. Sci., City Univ. of Hong Kong, Kowloon, Hong Kong); Pun, E.Y.B.; Chan, K.S.; Fan, Z.N.; Chu, P.K.

SO Electronics Letters (16 April 1998) vol.34, no.8, p.817-18. 10 refs.
Published by: IEE
Price: CCCC 0013-5194/98/$10.00
CODEN: ELLEAK ISSN: 0013-5194
SICI: 0013-5194(19980416)34:8L.817:PIII;1-F

good

DT Journal

TC Experimental

CY United Kingdom

LA English

AB The authors report the disordering in compressively strained **InGaAsP**/InP multiple quantum wells induced by 20 keV Ar+ plasma immersion ion implantation. With an Ar+ dose of 1016 cm2 and a subsequent standard furnace annealing at 650 degrees C for 90 min, the implanted sample exhibits an extra blue-shift of about 20 nm in comparison to the unimplanted control sample. For a sample that has been partially masked during implantation, a sharp **intermixing** step is observed after the 650 degrees C anneal, indicating that the technique has the potential of introducing a localised disordering effect and, hence, may be a viable fabrication technique for integrated photonic devices.

Ar.

CC A6170T Doping and implantation of impurities; A6865 Layer structures, intercalation compounds and superlattices: growth, structure and nonelectronic properties; A7865J Optical properties of nonmetallic thin films; A6170A Annealing processes; A7855D Photoluminescence in tetrahedrally bonded nonmetals; B2550B Semiconductor doping; B2530C Semiconductor superlattices, quantum wells and related structures; B2550A Annealing processes for semiconductor devices; B4220 Luminescent materials; B2520D II-VI and III-V semiconductors

CT ANNEALING; GALLIUM ARSENIDE; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; ION IMPLANTATION; PHOTOLUMINESCENCE; SEMICONDUCTOR QUANTUM WELLS

ST **compressively strained InGaAsP/InP multiple quantum well;** Ar+ plasma immersion ion implantation; blue shift; **intermixing;** furnace annealing; disorder; fabrication; integrated photonic device; 20 keV; 650 C; Ar; **InGaAsP-InP**

CHI Ar el; InGaAsP-InP int, InGaAsP int, InP int, As int, Ga int, In int, P int, InGaAsP ss, As ss, Ga ss, In ss, P ss, InP bin, In bin, P bin

PHP electron volt energy 2.0E+04 eV; temperature 9.23E+02 K

ET Ar; Ar+; Ar ip 1; ip 1; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAsP; In cp; cp; Ga cp; As cp; P cp; In*P; InP; C; V; InGaAsP-InP; As; Ga; In; P

L13 ANSWER 9 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1998:5801864 INSPEC DN A9804-4285-009; B9802-4270-022
TI Monolithic integration in InGaAs/**InGaAsP** multiple **quantum well** structures using laser and plasma processing.
AU Qiu, B.C.; Kowalski, O.P.; Bryce, A.C.; De La Rue, R.M.; Marsh, J.H. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK)
SO IEE Colloquium on Optoelectronic Integration and Switching (Ref. No.1997/372)
London, UK: IEE, 1997. p.1/1-5 of 104 pp. 7 refs.
Conference: Glasgow, UK, 13 Nov 1997
Sponsor(s): IEE; Scottish Chapter of IEEE/LEOS
DT Conference Article
TC Experimental
CY United Kingdom
LA English

plasma

AB Precise control over local optical and electrical characteristics across a semiconductor wafer is of fundamental importance for fabrication of photonic integrated circuits (PICs). Here we report the use of two basic **quantum well intermixing** (**QWI**) techniques, laser processing and plasma processing **induced disordering**. Extended cavity ridge lasers were fabricated using both techniques. The light-current (L-I) characteristics of lasers with and without extended passive waveguides were measured, and it was shown that threshold current has only a slight increase for the extended cavity lasers with 1 mm extended cavity compared to the lasers with no extended cavity. The losses in the passive section of the extended cavity lasers are calculated.
CC A4285D Optical fabrication, surface grinding; A4260D Laser resonators and cavities; A4260K Laser beam applications; A4255P Lasing action in semiconductors; A8115H Chemical vapour deposition; B4270 Integrated optoelectronics; B4320L Laser resonators and cavities; B4360 Laser applications; B4320J Semiconductor lasers; B2570 Semiconductor integrated circuits; B0510D Epitaxial growth; B2550 Semiconductor device technology
CT GALLIUM ARSENIDE; GALLIUM COMPOUNDS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; INTEGRATED CIRCUIT TECHNOLOGY; INTEGRATED OPTOELECTRONICS; LASER BEAM APPLICATIONS; LASER CAVITY RESONATORS; OPTICAL FABRICATION; **QUANTUM WELL** LASERS; SEMICONDUCTOR GROWTH; VAPOUR PHASE EPITAXIAL GROWTH
ST monolithic integration; **InGaAs/InGaAsP multiple quantum well structures**; laser processing; plasma processing; precise control; local optical characteristics; electrical characteristics; semiconductor wafer; photonic integrated circuit fabrication; **quantum well intermixing techniques**; **induced disordering**; extended cavity ridge lasers; **quantum well laser fabrication**; light-current characteristics; threshold current; extended cavity lasers; passive section; **InGaAs-InGaAsP**
CHI InGaAs-InGaAsP int, InGaAsP int, InGaAs int, As int, Ga int, In int, P int, InGaAsP ss, InGaAs ss, As ss, Ga ss, In ss, P ss
ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; InGaAs; In cp; cp; Ga cp; As cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; InGaAsP; P cp; Cs*I*P; PICs; I cp; Cs cp; I; V; InGaAs-InGaAsP; As; Ga; In; P

L13 ANSWER 10 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1997:5678714 INSPEC DN A9719-4260B-028; B9710-4320J-120
TI Extended cavity lasers fabricated using photo-absorption **induced disordering**.
AU McKee, A.; Lullo, G.; McLean, C.J.; Qiu, B.C.; Bryce, A.C.; De La Rue,

R.M.; Marsh, J.H. (Dept. of Electron. & Electr. Eng., Glasgow Univ., UK)
SO Conference Proceedings. 1997 International Conference on Indium Phosphide and Related Materials (Cat. No.97CH36058)
New York, NY, USA: IEEE, 1997. p.288-91 of xii+680 pp. 7 refs.
Conference: Cape Cod, MA, USA, 11-15 May 1997
Sponsor(s): IEEE Lasers & Electro-Opt. Soc.; IEEE Electron Devices Soc
Price: CCCC 0 7803 3898 7/97/$10.00
ISBN: 0-7803-3898-7
DT Conference Article
TC Practical; Theoretical; Experimental
CY United States
LA English
AB Photo-absorption **induced disordering** (PAID) has emerged as a laser induced **quantum well intermixing** technique of particular applicability to the **GaInAsP**/InP material system. Blue shifts in the bandgap of >100 meV in standard MQW laser structures are typically obtainable. The spatial selectivity of the technique is, however, limited by lateral heat flow. Here we show that extended cavity lasers can be fabricated by the PAID process, provided the graded interface region is pumped. The PAID process is modelled, and the ultimate spatial resolution is deduced.
CC A4260B Design of specific laser systems; A4260D Laser resonators and cavities; A4255P Lasing action in semiconductors; A4280R Gradient-index (GRIN) devices; A4260H Laser beam characteristics and interactions; A4285D Optical fabrication, surface grinding; B4320J Semiconductor lasers; B4320L Laser resonators and cavities; B4330 Laser beam interactions and properties
CT ENERGY GAP; GALLIUM ARSENIDE; GRADIENT INDEX OPTICS; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; LASER BEAM EFFECTS; LASER CAVITY RESONATORS; OPTICAL FABRICATION; **QUANTUM WELL** LASERS; SPECTRAL LINE SHIFT
ST extended cavity lasers; **photoabsorption induced disordering; laser induced quantum well intermixing technique**; pumped graded interface region; spatial resolution; III-V semiconductors; **GaInAsP-InP**
CHI GaInAsP-InP int, GaInAsP int, InP int, As int, Ga int, In int, P int, GaInAsP ss, As ss, Ga ss, In ss, P ss, InP bin, In bin, P bin
ET As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; Ga cp; cp; In cp; As cp; P cp; In*P; InP; V; GaInAsP-InP; As; Ga; In; P

L13 ANSWER 11 OF 22 INSPEC COPYRIGHT 2002 IEE
AN 1997:5650657 INSPEC DN A9717-4260F-010; B9709-4320J-045
TI Wavelength trimming of distributed-feedback lasers by photo-absorption-**induced disordering**.
AU Sudoh, T.K.; Kumano, M.; Nakano, Y.; Tada, K. (Dept. of Electron. Eng., Tokyo Univ., Japan)
SO Conference Proceedings. LEOS '96 9th Annual Meeting. IEEE Lasers and Electro-Optics Society 1996 Annual Meeting (Cat. No.96CH35895)
New York, NY, USA: IEEE, 1996. p.419-20 vol.2 of 2 vol. (xviii+400+xx+438) pp. 3 refs.
Conference: Boston, MA, USA, 18-19 Nov 1996
ISBN: 0-7803-3160-5
DT Conference Article
TC Experimental
CY United States
LA English
AB We have proposed the use of photo-absorption-**induced disordering** for post-fabrication adjustment of lasing wavelength (wavelength trimming), and demonstrated 0.36 nm trimming in a 1.55 mu m ridge waveguide DFB laser. The technique utilizes the band gap dependent absorption of the incident laser photons in **quantum well** (QW) layers, which generates heat and induces **intermixing** ofthe QW. The active region consisted of five compressively-strained 1.55 mu m

time constant; lateral diffusion; photoluminescence spectroscopy measurements; spatial resolution; time resolved photoluminescence; micro-Raman spectra; backscattering configuration; Au masked region; **GaInAs-GaInAsP**; YAG:Nd; YAl5O12:Nd

CHI GaInAs-GaInAsP int, GaInAsP int, GaInAs int, As int, Ga int, In int, P int, GaInAsP ss, GaInAs ss, As ss, Ga ss, In ss, P ss; YAl5O12:Nd ss, YAl5O12 ss, Al5O12 ss, Al5 ss, O12 ss, Al ss, Nd ss, O ss, Y ss, Nd el, Nd dop

ET As*Ga*In; As sy 3; sy 3; Ga sy 3; In sy 3; GaInAs; Ga cp; cp; In cp; As cp; As*Ga*In*P; As sy 4; sy 4; Ga sy 4; In sy 4; P sy 4; GaInAsP; P cp; V; P; Nd; In*P; InP; Au; GaInAs-GaInAsP; Al*O*Y; Al sy 3; O sy 3; Y sy 3; YAl5O; Y cp; Al cp; O cp; As; Ga; In; Al*O; Al5O; Al; O; Y

L13 ANSWER 7 OF 22 INSPEC COPYRIGHT 2002 IEE

AN 1998:6012543 INSPEC DN A9820-7340L-006; B9810-2530C-036

TI A large bandgap shift in InGaAs(P)/InP multi-**quantum well** structure obtained by impurity-free vacancy diffusion using SiO2 capping and its application to photodetectors.

AU Sang-Kee Si; Sung-June Kim; Ju-Han Lee; Deok Ho Yeo; Kyung Hun Yoon (Sch. of Electr. Eng., Seoul Nat. Univ., South Korea)

SO Proceedings of the SPIE - The International Society for Optical Engineering (1998) vol.3287, p.88-95. 10 refs.
Published by: SPIE-Int. Soc. Opt. Eng
Price: CCCC 0277-786X/98/$10.00
CODEN: PSISDG ISSN: 0277-786X
SICI: 0277-786X(1998)3287L.88:LBSI;1-H
Conference: Photodetectors: Materials and Devices III. San Jose, CA, USA, 28-30 Jan 1998
Sponsor(s): SPIE

DT Conference Article; Journal

TC Practical; Experimental

CY United States

LA English

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AB In this paper, we have investigated the bandgap tuning in the InGaAs(P)-InP multiquantum well structure obtained by impurity-free vacancy diffusion using low temperature photoluminescence (PL). The MQW **intermixing** was performed in a rapid thermal annealer (RTA) using the dielectric capping materials, SiO2 and SiNx. The SiO2 capping was successfully used with InGaAs cap layer to cause a large bandgap tuning effect in the InGaAs/InP MQW material. The blue shift of bandgap energy after RTA treatment was as much as 185 and 230 meV at 750 degrees C and 850 degrees C, respectively, with its value controllable using annealing time and temperature. Samples with SiO2-InP or SiNx-InGaAs cap layer combinations, on the other hand, did not show any significant energy shifts. The absorption spectra taken from the same samples confirmed the energy shifts obtained using PL. The process development can be readily applied to fabrication of photodetectors that are sensitive to wavelength and/or polarization.

CC A7340L Semiconductor-to-semiconductor contacts, p-n junctions, and heterojunctions; A7865J Optical properties of nonmetallic thin films; A7320D Electron states in low-dimensional structures; A7855D Photoluminescence in tetrahedrally bonded nonmetals; A0762 Detection of radiation (bolometers, photoelectric cells, i.r. and submillimetre waves detection); A6170A Annealing processes; A6822 Surface diffusion, segregation and interfacial compound formation; B2530C Semiconductor superlattices, quantum wells and related structures; B4220 Luminescent materials; B7230C Photodetectors; B2550A Annealing processes for semiconductor devices

CT CHEMICAL INTERDIFFUSION; ENERGY GAP; GALLIUM ARSENIDE; III-V SEMICONDUCTORS; INDIUM COMPOUNDS; INFRARED SPECTRA; PHOTODETECTORS; PHOTOLUMINESCENCE; RAPID THERMAL ANNEALING; SELF-DIFFUSION; SEMICONDUCTOR QUANTUM WELLS; SPECTRAL LINE SHIFT; VACANCIES (CRYSTAL)